Wildlife Forensic Genetics

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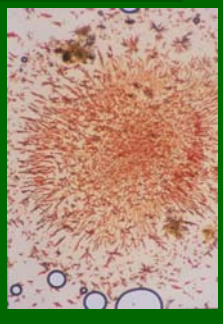
All Crime Labs

- **Identify physical evidence**
- **Analyses link:**
  - **Victim**
  - **Suspect**
  - **Crime Scene**

Serology Evidence



Forensic Science In Court

"Daubert" criteria for admissibility of federal expert witness testimony

- **Judge becomes 'gatekeeper'**
- **Can be tested using scientific hypothesis**
- **Method is reproducible and reliable**
- **Method widely accepted in field (usually equated with being published)**
- **Error rate can be established**
- **Criteria can vary between states**

Goal of Non-human DNA Analysis

- **Individual Identification ("matching")**
- **Gender determination**
- **Population identification**
- **Family Identification**
- **Species determination**

Why a crime lab for wildlife?

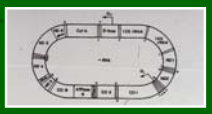
The fate of reintroduced wolves ...

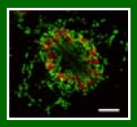
Number of Large Mammals in North America

Humans	**410,000,000**
White-tailed Deer	**19,600,000**
Mule Deer	**5,600,000**
Caribou	**2,500,000**
Feral Swine	**1,500,000**
Moose	**832,000**
Elk	**772,000**
Black Bear	**500,000**

DNA Analysis

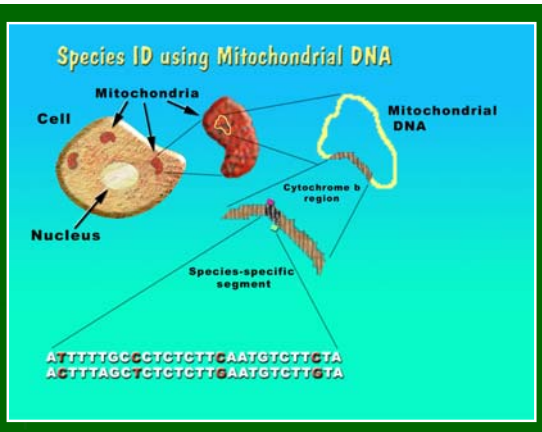
- Mitochondrial DNA
  - Species ID
  - Maternal Lineage
  - Population Determination
- Genomic DNA
  - Gender Determination
  - Parentage Determination
  - Individualization





Added Considerations for DNA Analysis of Wildlife

- Most crime labs generally deal with one species – *Homo sapiens*
- Wildlife crime labs need to be able to deal with every other species
- Must know or determine species of origin, in addition to DNA analysis



mtDNA sequence used to determine species from diverse samples

- **Analysis in 3-5 days**
- **Examples:**
  - **Caviar**
  - **Bear**
  - **Wolves**
  - **Exotic Species**

DNA Matching

To be able to "individualize" any animal - that is conclude that two evidence items have the same source - a database must be established. That database must take into account the following criteria:

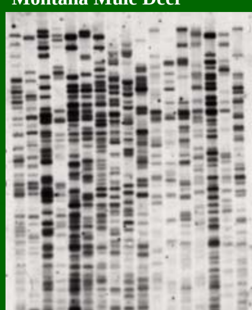
- Sample size and location
- Population distribution
- Breeding habits
- Number of loci
- Any linkage of loci

Methods for Matching Evidence using DNA Analysis

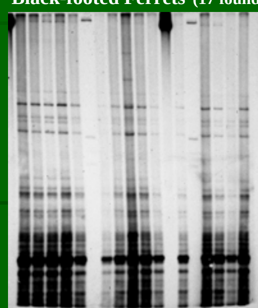
- Multilocus minisatellite (DNA fingerprints)
- PCR-based microsatellite repeats (short tandem repeats, or STRs)

Multilocus Variability

Montana Mule Deer



Black-footed Ferrets (17 founders)



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After DNA tests, 3 admit poaching

Shot buck on Clint Eastwood's ranch

By Jonathan Franks
Bee Correspondent

REDDING – Three deer hunters accused of illegally shooting a trophy buck on actor Clint Eastwood's Rising River Ranch in eastern Shasta County pleaded guilty Monday to a variety of poaching charges, a state Department of Fish and Game official said.

Department spokesman Paul Wertz said it was the first successful use of DNA matching techniques in a California poaching prosecution. Tests run by the U.S. Fish and Wildlife Service forensics lab in Ashland, Ore. last January linked a pile of deer entrails found on Eastwood's ranch near Cassel with a carcass held by one of the hunters.

of the younger Allee showed it had been killed the night before on private land. He claimed he'd killed it on opening morning in a legal hunting zone.

Eastwood and several other ranch owners in the area were prepared to identify in court what Wertz called the "massive trophy buck" as one they had observed many times in the area, Wertz said.

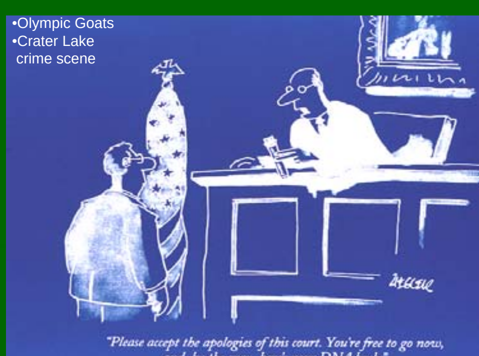
But that proved unnecessary.

"Normally, we'd have had to build a case with circumstantial evidence," said Wertz. But DNA tests run by the U.S. Fish and Wildlife Service left the defendants little alternative but to plead guilty, Wertz said.

Allee Sr. and Lyons pleaded guilty to delaying an officer and were sentenced to two years' pro-

Evidence often exonerates

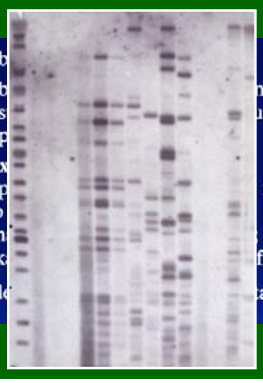
- •Olympic Goats
- •Crater Lake crime scene



Population genetics of salami

Meat sellers admit mislabeling sausage

Poisoning cases - who dunnit?



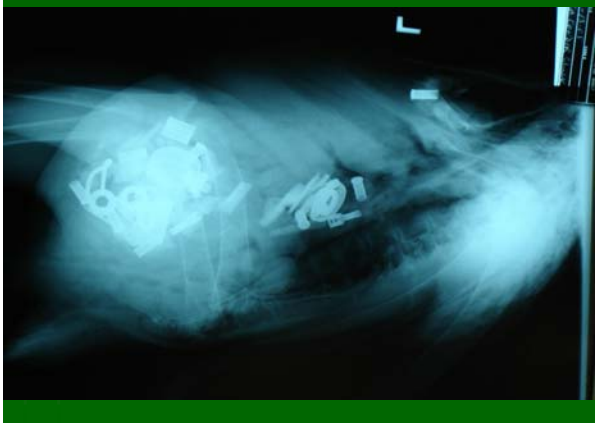
Animals: b
Crime: b
s
p
Evidence ex
1) samp
2) crop
3) stom
4) pack
All items d

ntly poisoned by
unlawful take of

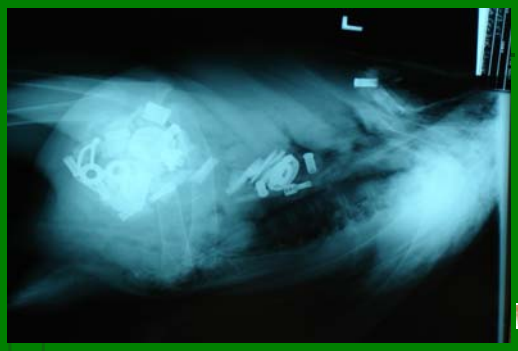
from the field;

and
freezer

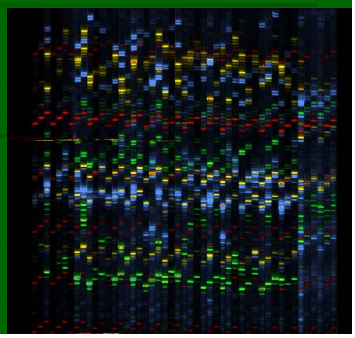
ailed deer.



Condor collected alive in April 2005



Example of STR Analysis by fluorescence using a 6 primer multiplex



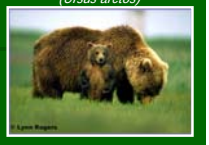
Bear Family (Ursidae)

Asiatic Black Bear
(Ursus thibetanus)

Sun bear
(*Helarctos malayanus)*

N.A. Black bear
(Ursus americanus)

Brown bear
(Ursus arctos)



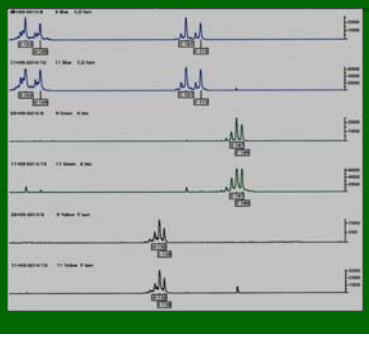
Polar bear
(Ursus maritimus)

Gallbladder Identification

Bear Parts in Commercial Trade

Bear Gallbladder Trade

Matching bear tooth with gallbladder, Shenandoah NP



Molecular Identification of Cypripedioid Orchids In International Trade

Sequenced three regions of DNA in rarest species:

ITS rDNA
trnS-M chloroplast
NAD1 mtDNA

Phylogenetic analysis clearly distinguishes between the two target genera (*Paphiopedilum* and *Phragmipedium*) and among other "outgroups"

Sections of closely related taxa were recoverable in many cases (i.e., analysis allows finer resolution than to genus)

Library of sequences now exist for comparisons to allow rapid assessment and avoid unnecessary complications in the legitimate trade

USGS

Some Lessons from the Lab

- Don't analyze evidence unless you are willing to testify in court
- Contamination is the first line of attack
- Your conclusions are only as strong as the database that supports them
- Specials agents, park rangers and the police are under different selection pressures than lab scientists